

CLAIMS

What is claimed is:

1. A radio communications system comprising:
 - an antenna array adapted to transmit and receive radio communications signals with a plurality of other terminals the communications signals each using a particular minimum bandwidth;
 - a transmit chain to transmit a calibration signal through the antenna array to a transponder;
 - a receive chain to receive through the antenna array a transponder signal from the transponder, the transponder signal being based on the calibration signal and having a bandwidth narrower than the minimum bandwidth; and
 - a signal processor to measure characteristics of the transponder signal as received through the receive chain.
2. The system of claim 1, wherein the calibration signal has a bandwidth narrower than the minimum bandwidth.
3. The system of claim 1, wherein the transponder signal is reduced in carrier bandwidth and converted in frequency as compared to the calibration signal.
4. The system of claim 1, wherein the measured characteristics of the transponder signal include phases and amplitudes.
5. The system of claim 4:
 - wherein the receive chain comprises a plurality of receive chains;
 - wherein each receive chain receives the transponder signal; and
 - wherein the signal processor determines a receive calibration vector by comparing the phases and amplitudes of the transponder signal as received by each receive chain.

1 6. The system of claim 5 wherein the signal processor determines the receive
2 calibration vectors by forming a vector whose complex elements have phases and
3 amplitudes corresponding to the relative difference in phase and amplitude of the
4 channels from each receive chain.

1 7. The system of claim 5, wherein each receive chain comprises a receive
2 channel from an antenna to the conversion to a digital representation of the received
3 signal.

1 8. The system of claim 5, wherein one of the plurality of receive chains is
2 selected as a reference chain and the complex elements of phase and amplitude of the
3 receive calibration vector for the reference chain are set equal to one.

1 9. The system of claim 5, wherein the receive calibration vector is formed by
2 averaging several receive calibration vectors.

1 10. The system of claim 5 wherein the signal processor determines a transmit
2 calibration vector using measured phases and amplitudes of several receptions of the
3 transponder signal.

1 11. The system of Claim 4 wherein the signal processor determines an uplink
2 signature of the transponder at the antenna array using the measured phases and
3 amplitudes of the transponder signal.

1 12. The system of Claim 11 wherein the signal processor further determines a
2 receive calibration vector for the receive chain using the uplink signature of the
3 transponder.

1 13. The system of Claim 4 wherein the signal processor determines a
2 downlink signature of the transmit chain at the transponder using the measured phases
3 and amplitudes of the transponder signal.

1 14. The system of Claim 13 wherein the signal processor further determines a
2 transmit calibration vector for the transmit chain using the downlink signature of the
3 transmit chain.

1 15. The system of claim 1:
2 wherein the transmit chain comprises a plurality of transmit chains;
3 wherein each transmit chain transmits the calibration signal; and
4 wherein the signal processor determines a downlink signature of the transmit
5 chain at the transponder by comparing the calibration signal from each transmit chain as
6 reflected in the measured characteristics of the transponder signal.

1 16. The system of claim 15, wherein the calibration signal comprises a
2 plurality of signals, one from each transmit chain, each signal being individually
3 identifiable based on a unique spreading function.

1 17. The system of claim 15, wherein the calibration signal comprises a
2 plurality of signals, one from each transmit chain, each signal being individually
3 identifiable based on a unique modulation sequence.

1 18. The system of claim 15, wherein the measured characteristics of the
2 transponder signal include phases and amplitudes and wherein the signal processor
3 determines a transmit calibration vector by forming a vector whose complex elements
4 have phases and amplitudes corresponding to the relative difference in phase and
5 amplitude of the channels from each transmit chain.

1 19. The system of Claim 15 wherein one of the plurality of transmit chains is
2 selected as a reference chain and the complex elements of phase and amplitude of the
3 transmit calibration vector defined with reference to the reference chain.

20. The system of claim 15, wherein the transmit calibration vector is formed by averaging several transmit calibration vectors.

21. The system of claim 1, wherein the antenna array includes a plurality of antennas each of which transmits and receives signals.

22. The system of claim 1, wherein the antenna array includes a first plurality of antennas for transmitting the calibration signal and a second plurality of antennas for receiving the transponder signal.

23. The system of claim 22:
 wherein each antenna has a corresponding transmit chain and a corresponding receive chain;
 wherein each transmit chain transmits the calibration signal;
 wherein each receive chain receives the narrowband transponder signal based on the transmitted calibration signal; and
 wherein the signal processor determines a transmit calibration vector by comparing the calibration signal from each transmit chain as reflected by the measured characteristics and determines a receive calibration vector by comparing the transponder signal received at each receive chain as reflected by the measured characteristics.

24. The system of claim 23, wherein the calibration signal is transmitted substantially simultaneously from each transmit chain.

25. The system of claim 23, wherein the receive calibration vector and the transmit calibration vector are determined based on the same transponder signal reception.

1 26. The system of claim 1, wherein the antenna array, receive chain and
2 transmit chains are components of a code division multiple access cellular
3 communications system.

1 27. A method comprising:
2 transmitting a calibration signal from an antenna array, the antenna array being
3 adapted to transmit and receive radio communication signals each using a particular
4 minimum bandwidth;
5 receiving a transponder signal at the antenna array, the transponder signal being
6 based on the calibration signal and having a bandwidth narrower than the minimum
7 bandwidth; and
8 measuring characteristics of the transponder signal as received through the receive
9 chain.

1 28. The method of claim 27, further comprising generating a calibration
2 vector using the measured characteristics.

1 29. The method of claim 27, further comprising generating a transmit
2 calibration vector by comparing the transponder signal as received by the individual
3 elements of the transmit antenna array using the measured characteristics.

1 30. The method of claim 27, wherein transmitting comprises transmitting a
2 calibration signal having a bandwidth narrower than the minimum bandwidth using the
3 antenna array.

1 31. The method of claim 27, wherein the transponder signal is frequency
2 shifted in comparison to the calibration signal.

1 32. The method of claim 27, wherein each antenna has a corresponding
2 transmit chain and a corresponding receive chain, wherein transmitting comprises
3 transmitting the calibration signal from each transmit chain, wherein receiving comprises
4 receiving the transponder signal at each receive chain, and further comprising
5 determining a transmit calibration vector by comparing the calibration signal from each
6 transmit chain as received as a transponder signal by each receive chain.

1 33. The method of claim 27, wherein the calibration signal is transmitted
2 substantially simultaneously from each transmit chain.

1 34. The method of claim 28 further comprising generating a transmit
2 calibration vector using the measured characteristics of the transponder signal as received
3 by individual antenna elements.

1 35. The method of claim 34, further comprising generating a receive
2 calibration vector by comparing the measured characteristics of the transponder signal as
3 received by the individual antenna elements.

1 36. The method of claim 27 further comprising determining a spatial signature
2 for the transponder signal using the measured characteristics as received through the
3 receive chain.

1 37. The method of claim 36 wherein determining a spatial signature comprises
2 determining an uplink spatial signature by comparing the transponder signal as received
3 by each receive chain.

1 38. The method of claim 36, wherein determining the spatial signature
2 comprises forming a vector whose complex elements have phases and amplitudes
3 corresponding to the relative difference in phase and amplitude of the channels from
4 each receive chain.

1 39. The method of claim 36, further comprising determining calibration
2 vectors for the receive chain and the transmit chain using the spatial signature.

1 40. The method of claim 36, wherein the spatial signature is formed by averaging
2 several spatial signatures.

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1. Demographic characteristics		2. Health status		3. Health care utilization		4. Health care costs		5. Health care satisfaction		6. Health care quality		7. Health care access		8. Health care equity		9. Health care effectiveness		10. Health care efficiency		11. Health care safety		12. Health care innovation		13. Health care sustainability		14. Health care resilience		15. Health care adaptability		16. Health care responsiveness		17. Health care transparency		18. Health care accountability		19. Health care integrity		20. Health care trustworthiness		21. Health care reliability		22. Health care predictability		23. Health care consistency		24. Health care uniformity		25. Health care standardization		26. Health care certification		27. Health care accreditation		28. Health care regulation		29. Health care supervision		30. Health care monitoring		31. Health care evaluation		32. Health care improvement		33. Health care innovation		34. Health care sustainability		35. Health care resilience		36. Health care adaptability		37. Health care responsiveness		38. Health care transparency		39. Health care accountability		40. Health care integrity		41. Health care trustworthiness		42. Health care reliability		43. Health care predictability		44. Health care consistency		45. Health care uniformity		46. Health care standardization		47. Health care certification		48. Health care accreditation		49. Health care regulation		50. Health care supervision		51. Health care monitoring		52. Health care evaluation		53. Health care improvement		54. Health care innovation		55. Health care sustainability		56. Health care resilience		57. Health care adaptability		58. Health care responsiveness		59. Health care transparency		60. Health care accountability		61. Health care integrity		62. Health care trustworthiness		63. Health care reliability		64. Health care predictability		65. Health care consistency		66. Health care uniformity		67. Health care standardization		68. Health care certification		69. Health care accreditation		70. Health care regulation		71. Health care supervision		72. Health care monitoring		73. Health care evaluation		74. Health care improvement		75. Health care innovation		76. Health care sustainability		77. Health care resilience		78. Health care adaptability		79. Health care responsiveness		80. Health care transparency		81. Health care accountability		82. Health care integrity		83. Health care trustworthiness		84. Health care reliability		85. Health care predictability		86. Health care consistency		87. Health care uniformity		88. Health care standardization		89. Health care certification		90. Health care accreditation		91. Health care regulation		92. Health care supervision		93. Health care monitoring		94. Health care evaluation		95. Health care improvement		96. Health care innovation		97. Health care sustainability		98. Health care resilience		99. Health care adaptability		100. Health care responsiveness		101. Health care transparency		102. Health care accountability		103. Health care integrity		104. Health care trustworthiness		105. Health care reliability		106. Health care predictability		107. Health care consistency		108. Health care uniformity		109. Health care standardization		110. Health care certification		111. Health care accreditation		112. Health care regulation		113. Health care supervision		114. Health care monitoring		115. Health care evaluation		116. Health care improvement		117. Health care innovation		118. Health care sustainability		119. Health care resilience		120. Health care adaptability		121. Health care responsiveness		122. Health care transparency		123. Health care accountability		124. Health care integrity		125. Health care trustworthiness		126. Health care reliability		127. Health care predictability		128. Health care consistency		129. Health care uniformity		130. Health care standardization		131. Health care certification		132. Health care accreditation		133. Health care regulation		134. Health care supervision		135. Health care monitoring		136. Health care evaluation		137. Health care improvement		138. Health care innovation		139. Health care sustainability		140. Health care resilience		141. Health care adaptability		142. Health care responsiveness		143. Health care transparency		144. Health care accountability		145. Health care integrity		146. Health care trustworthiness		147. Health care reliability		148. Health care predictability		149. Health care consistency		150. Health care uniformity		151. Health care standardization		152. Health care certification		153. Health care accreditation		154. Health care regulation		155. Health care supervision		156. Health care monitoring		157. Health care evaluation		158. Health care improvement		159. Health care innovation		160. Health care sustainability		161. Health care resilience		162. Health care adaptability		163. Health care responsiveness		164. Health care transparency		165. Health care accountability		166. Health care integrity		167. Health care trustworthiness		168. Health care reliability		169. Health care predictability		170. Health care consistency		171. Health care uniformity		172. Health care standardization		173. Health care certification		174. Health care accreditation		175. Health care regulation		176. Health care supervision		177. Health care monitoring		178. Health care evaluation		179. Health care improvement		180. Health care innovation		181. Health care sustainability		182. Health care resilience		183. Health care adaptability		184. Health care responsiveness		185. Health care transparency		186. Health care accountability		187. Health care integrity		188. Health care trustworthiness		189. Health care reliability		190. Health care predictability		191. Health care consistency		192. Health care uniformity		193. Health care standardization		194. Health care certification		195. Health care accreditation		196. Health care regulation		197. Health care supervision		198. Health care monitoring		199. Health care evaluation		200. Health care improvement		201. Health care innovation		202. Health care sustainability		203. Health care resilience		204. Health care adaptability		205. Health care responsiveness		206. Health care transparency		207. Health care accountability		208. Health care integrity		209. Health care trustworthiness		210. Health care reliability		211. Health care predictability		212. Health care consistency		213. Health care uniformity		214. Health care standardization		215. Health care certification		216. Health care accreditation		217. Health care regulation		218. Health care supervision		219. Health care monitoring		220. Health care evaluation		221. Health care improvement		222. Health care innovation		223. Health care sustainability		224. Health care resilience		225. Health care adaptability		226. Health care responsiveness		227. Health care transparency		228. Health care accountability		229. Health care integrity		230. Health care trustworthiness		231. Health care reliability		232. Health care predictability		233. Health care consistency		234. Health care uniformity		235. Health care standardization		236. Health care certification		237. Health care accreditation		238. Health care regulation		239. Health care supervision		240. Health care monitoring		241. Health care evaluation		242. Health care improvement		243. Health care innovation		244. Health care sustainability		245. Health care resilience		246. Health care adaptability		247. Health care responsiveness		248. Health care transparency		249. Health care accountability		250. Health care integrity		251. Health care trustworthiness		252. Health care reliability		253. Health care predictability		254. Health care consistency		255. Health care uniformity		256. Health care standardization		257. Health care certification		258.	
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1 41. A calibration transponder for use in a radio communications system
2 comprising:
3 a receive antenna to receive a wideband calibration signal from a system to be
4 calibrated;
5 a bandpass filter to convert the wideband calibration signal into a narrowband
6 signal; and
7 a transmit chain including a transmit antenna to transmit the narrowband signal to
8 the system to be calibrated.

1 42. The transponder of claim 41, wherein the calibration signal is a spread
2 spectrum signal, the transponder further comprising a filter to convert the spreading code
3 of the calibration to a different spreading code.

1 43. The transponder of claim 41, further comprising a mixer to convert the
2 frequency of the calibration signal to a different frequency before transmitting.